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THE EXPLORATION OF THE PACIFIC

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Read before the Academy, April 17, 1916. Received May 25, 1916

A voyage across the Pacific, such as the Shaler Memorial voyage that I made two years ago, gives a traveller time on the free days between groups of islands to think of many problems, old and new; and thoughts of unsolved problems tend to run on into dreams about their possible solution. Even after returning home, the dreams continue in intervals of rest between spells of work on the results of the voyage; for just as the unrecorded facts that one so often finds while in the broad ocean impress their observer with the great volume of work still to be done, so the records of earlier work which one reads in a home library too frequently disappoint him by their incompleteness, their insufficience; thus at home and abroad, the wish of a fuller accomplishment is repeatedly present.

The insufficience of earlier work and hence the abundant opportunity for new work was first borne in upon me in connection with the old problem of coral reefs, to the investigation of which my own voyage was directed. This does not mean that a later traveller is ungrateful for what his predecessors have done, but that he need not carry gratitude to the point of being thankful to them for having left so rich and ripe a harvest to be gathered by their successors. Nor would a reference to the insufficience of earlier work be just, if the insufficiency concerned matters or methods unknown in earlier years. But when their insufficiency concerns truths so well established as the geological principle of unconformity and the physiographic principle of embayed shores, known and understood, one for a century, the other for half a century past, and directly pertinent in the problem of coral reefs, one must wonder in how many other directions the work thus far performed in the Pacific is incomplete. A student of coral reefs today cannot avoid regret at the repeated failure of earlier observers to note matters so manifest as the embayed shore lines of the central islands within barrier reefs, and the unconformable contacts of many fringing and elevated reefs with their deeply eroded foundations, inasmuch as these simple and evident relations immediately demonstrate submergence in association with reef formation, and thus contribute valiantly to the solution of the old coral-reef problem. With the regretful discovery of such oversights with respect to one's own special subject in the records of the most famous Pacific expeditions, one cannot avoid suspecting the occurrence of similar oversights in other subjects, and one must thereupon experience a great wish to see thorough and comprehensive work instituted in all subjects with the least possible delay.

For example, following the belief of the eminent Austrian geologist, Suess, regarding changes of ocean level, two responsible students of coral reefs, who must certainly have been regarded as competent investigators by the institutions that sent them forth on their travels, have independently announced that certain high-standing atolls owe their altitude to a subsidence of the ocean—the entire ocean—while these atolls, little specks in the vast ocean, stood fixed: yet it may be easily shown that that explanation is preposterously inadequate to account for the total facts. Hence, if inadequate treatment has been given to so fundamental a problem as this, is it too much to say that the more recondite problems of the Pacific cannot be solved by the methods heretofore in use? Even subjects of so large dimensions as the circulation of the atmosphere over the Pacific and of the Pacific waters in their basin are known to us only in the most general way; like many other subjects, our knowledge of them comes from records made by observers little trained in special fields. It cannot be doubted that large rewards will follow from exploration systematically carried on by trained specialists.

Adventurous voyages of discovery sufficed in the eighteenth century, when the method of exploration may be described as discontinuous and local. Less adventurous and more scientific voyages of investigation in the nineteenth century made brave attack on many problems by a method that may be described as continuous and linear. Now, so exacting have the demands of science become that nothing less than an areal survey of the Pacific will satisfy them; that is, a survey in which all the islands shall be included, and in which the successive routes of linear observation on the ocean shall be so closely interwoven that, like the work of the magnetic survey of the Pacific by the Carnegie Institution of Washington, the results gained may be reasonably regarded as applicable to the intermediate spaces.

The exploration of the Pacific should not only be continuous in the areal sense, but continued in the time sense. Many problems will call for 'one voyage to learn,' however careful the preparation before setting out. Exploration should therefore be continued through a number of years under one administration, so that the voyaging staff may gain in the early voyages the expertness needed for the solution of their difficult tasks in the later voyages. Many returns must be made to critical points, where first observations regarding air, water, land, or life will hardly do more than open up the more complicated subjects for investigation; for Pacific exploration should not only be continuous in the areal sense, and continued in the time sense, but comprehensive in every sense. It should reach from the depths of the sea to the heights of the air; from the cold waters of the North, narrowly limited in their connection with the Arctic ocean, across the torrid zone, to the cold waters of the South, broadly continuous with the Antarctic; from the little broken shores of continental America to the repeatedly interrupted shores of half-drowned Australasia; it should include all the islands of the open ocean, and all forms of life from bacteria to man.

The exploration of the Pacific is not a new theme. The voyages of Magellan, Cook, and others gave it early fame. The United States Exploring Expedition under Captain, later Commodore, Wilkes made a great advance 80 years ago. Forty years afterwards, the 'Challenger' did forty-years better; and yet we now learn from the refined studies of Norwegian hydrographers that the errors of certain instruments in the 'Challenger' outfit were greater than the variations of fact which those instruments were intended to measure. An interesting but sporadic and not long-lasting effort at Pacific exploration was made some 40 years ago by the Museum Godeffroy, founded at Hamburg by a firm of merchants: the Dutch Government has carried on scientific investigations of many kinds in its East Indian possessions, bordering the Pacific; much excellent work is now in process at the Bishop Museum, centrally located at Honolulu, where the great galleries of collections open to the public are backed by a large building devoted to research laboratories. The Hawaiian Islands seem, indeed, to be a center of inspiration on our subject, for a resident there, Prof. W. A. Bryan, elaborated a general scheme of Pacific exploration several years ago, and a recent visitor, Prof. R. A. Daly, has lately discussed the same problem; and in Hawaii as well as in the Philippines our governmental bureaus are prosecuting cartographic and other surveys. Specialists cross the Pacific from time to time on particular quests; the following papers will tell something of such work by Messrs. Briggs, Iddings, Pilsbry and Campbell. But the Pacific is vast. Discontinuous, local or linear, invidual work, economically conducted, cannot, however excellent, compass the immense extent and the infinite variety of that great water hemisphere. Thorough-going Pacific exploration will demand most munificent support.

It has been urged by some of those with whom I have talked on the financial side of the scheme that the present troublous times are not propitious for its launching. True; and we are not launching it now; we are only laying its keel. But these troublous times cannot last indefinitely; they will be past before we have had time—two, three, or four years—for the deliberate development of our plans. It is therefore with no idea of immediate action that the dreams of certain spare hours and days in the last two years have here been written down in brief outline; nor is it with the least intention or expectation on my part of sharing in the work of exploration, if the dreams are realized, that the outline is here presented. The work must be done by men of middle age or less, and they must be selected and directed by whomsoever brings the dreams into execution. If some antipodal Croesus rise to the occasion, the plan is his and welcome; but I believe that, if the plan is carried out at all, it will be by Americans, to whom the scientific conquest of the Pacific may make strong appeal. Even after the war is over, European munificence, if any of it survive, will be heavily burdened with home duties: and while the war lasts, even American capital may be so largely invested in commercial enterprises that little of it will be diverted to science: but when peace comes it is by no means beyond the limit of possibilities that our plan may arouse the interest of an American patron; for America's outlook upon the Pacific is large. Hence, in scientific as well as in national affairs, preparedness may well be our motto; and the first step in preparedness is—not a precipitate plunge into uncorrelated action—but the careful consideration of a comprehensive plan.

All that can be accomplished today is, to summarize a few of the broad problems that have been opened but not closed in the greatest of the world's oceans; and this will be done by the following speakers, who have generously responded to my appeal. Each one will touch briefly on certain topics—merely a few of many—yet representative, each one of all. I shall at some later time ask again if the whole subject, of which a few parts now are to be set before us, is not worthy of further consideration by the Academy, in the hope—not a vain hope, I believe—that the preparation of a well developed plan of investigation may be the prelude to a grand undertaking and a superb accomplishment.

THE IMPORTANCE OF GRAVITY OBSERVATIONS AT SEA ON THE PACIFIC

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Read before the Academy, April 17, 1916. Received, May 24, 1916

The time is ripe for decided advances in our knowledge of geodesy and geology to be made by a study of observed values of gravity. Observations for this purpose are needed at sea, especially—rather than